

Application No. 10/582,548
Paper Dated: September 13, 2010
In Reply to USPTO Correspondence of May 12, 2010
Attorney Docket No. 3163-061714

REMARKS

I. Introduction

The final Office Action of May 12, 2010 has been reviewed and the Examiner's comments carefully considered. Claims 1-8 and 16 were previously pending in this application. The present Amendment amends claim 1 and adds new claim 17 all in accordance with the originally-filed specification. No new matter has been added. Specifically, support for the amendment to claim 1 can be found on page 12, lines 18-20 and page 17, lines 24-30 of the specification of the above-referenced application. Accordingly, claims 1-8, 16 and 17 are currently pending, and claim 1 is in independent form. The Applicants respectfully request entry of these amendments and allowance of pending claims 1-8, 16, and 17.

II. Interview of August 5, 2010

The Applicants would like to thank Examiner Marks for the courtesies extended to the Applicants' representative during the telephonic interview of August 5, 2010. During the interview, the details of the present invention and differences between the present invention and the cited prior art were discussed. No agreement as to allowability was reached with the Examiner during the course of the interview. However, the Examiner indicated that the present prior art rejection may be overcome by amending the claims to more explicitly define the rounded shape of the projecting parts of the negative electrodes as shown in FIG. 1 and described on page 6, line 22 to page 7, line 29 of the specification of the present invention. Accordingly, the Applicants have presented new claim 17 directed to this feature of the present invention.

III. 35 U.S.C. § 103 Rejection

Claims 1-8 and 16 stand rejected under 35 U.S.C. §103(a) for obviousness over United States Patent Application Publication No. 2003/0026063 to Munshi (hereinafter "the Munshi publication") in view of United States Patent No. 6,797,428 to Skotheim et al. (hereinafter "the Skotheim patent") and the article entitled "In situ SEM study of the interfaces in plastic lithium cells" to Orsini et al. (hereinafter "the Orsini publication").

As defined by independent claim 1, the present invention is directed to an electricity storage device that includes a polymer electrolyte and polarizable electrodes. The polarizable electrodes each comprise an interface with the polymer electrolyte. The polarizable electrodes are metal electrodes. A negative electrode of the polarizable electrodes has, at its interface with the polymer electrolyte, a lithium alloy with a metal component contained in the negative electrode. The lithium alloy is capable of releasing lithium ions through a reversible electrochemical oxidation-reduction reaction. The negative electrode is formed in the polymer electrolyte such that the polymer electrolyte includes the metal component and a polymer electrolyte component. The metal component is rich in a region in a vicinity of an outer side of the polymer electrolyte, and the polymer electrolyte component is rich in a region in a vicinity of a center of the polymer electrolyte. The polymer electrolyte is sandwiched between the negative electrode and a positive electrode.

Independent claim 1 has been amended to further require the polymer electrolyte to be sandwiched between the negative electrode and a positive electrode. Support for this amendment can be found on page 12, lines 18-20 which provides that, “[i]n the electricity storage device of the present invention, the metal electrodes are used as the positive electrode and the negative electrode”. In addition, the specification of the present invention further provides that “the electricity storage device of the present invention can be configured such that the metal electrode layer and the electrolyte layer do not have a definite interface by visual inspection, and the electrolyte portion having a resistance value as the electrolyte layer contains metal as a main component and is sandwiched between the portions having the good current-carrying property which are usable as electrodes” (see page 17, lines 24-30).

The Munshi publication is directed to an electrochemical capacitor (100) that includes a polymer thin film (12), a liquid electrolyte absorbed in the polymer thin film (12), and thin flexible active electrode layers constituting anode (10) and cathode (30) composed of energy dense material of high intrinsic surface area positioned at either side of the electrolyte-retaining polymer thin film (12) to tightly sandwich it between the electrode layers. The capacitor (100) includes a polymer electrolyte in which a polymer thin film (12) is cast from the base polymer and impregnated with the electrolyte solution, which contains a salt for ionic conduction (see

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FIGS. 1A-1C and 2).

The Munshi publication, whether considered alone or in combination with the Skotheim patent and the Orsini publication, does not teach or suggest that the negative electrode includes a lithium alloy with a metal component provided at the interface with the polymer electrolyte or that the negative electrode is formed in the polymer electrolyte such that the polymer electrolyte includes the metal component and a polymer electrolyte component where the metal component is rich in a region in a vicinity of an outer side of the polymer electrolyte, and the polymer electrolyte is rich in a region in a vicinity of a center of the polymer electrolyte as required by amended independent claim 1. The Examiner admits that the Munshi publication fails to teach or suggest that the negative electrode includes a lithium alloy with a metal component provided at the interface with the polymer electrolyte on page 3 of the final Office Action.

However, the Examiner contends that the Skotheim patent discloses the use of a negative electrode that comprises a lithium alloy with a metal component. While the Skotheim patent discloses an anode active layer that includes a first layer of lithium metal, a second layer of a temporary protective material such as copper or gold, and a multilayer structure in contact with a surface of the second layer (*see* column 16, lines 24-45), there is no teaching or suggestion in the Skotheim patent that this lithium layer is provided at an interface with a polymer electrolyte as required by independent claim 1.

In addition, the capacitor disclosed in the Munshi publication, whether considered alone or in combination with the Skotheim patent and the Orsini publication, does not have the same structure as the claimed electricity storage device. More specifically, the Munshi publication does not teach or suggest that the negative electrode is formed in the polymer electrolyte such that the polymer electrolyte includes the metal component and a polymer electrolyte component where the metal component is rich in a region in a vicinity of an outer side of the polymer electrolyte, and the polymer electrolyte is rich in a region in a vicinity of a center of the polymer electrolyte as required by amended independent claim 1. The Skotheim patent and the Orsini publication do not cure this deficiency.

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Furthermore, the combination of the Munshi publication and the Skotheim patent does not teach or suggest that the negative electrode is formed in the polymer electrolyte such that the polymer electrolyte includes the metal component and a polymer electrolyte component; that the metal component is rich in a region in a vicinity of an outer side of the polymer electrolyte; and that the polymer electrolyte is rich in a region in a vicinity of a center of the polymer electrolyte as required by independent claim 1. However, the Examiner relies on the Orsini publication as disclosing such a feature. The Examiner relies on the description in the Orsini publication that during the charging of a lithium battery, tangled and ramified dendrites grow at the lithium-polymer interface as providing support for a conclusion that such dendrites would cause the lithium to be rich in the outer regions of the electrolyte and would cause the electrolyte to be rich in the center. However, there is no support for such a conclusion in the Orsini publication. The Orsini publication does not teach or suggest that the metal component is rich in a region in a vicinity of an outer side of the polymer electrolyte or that the polymer electrolyte is rich in a region in a vicinity of a center of the polymer electrolyte as required by independent claim 1.

In addition, there is no teaching or suggestion in the Orsini publication that the polymer electrolyte is sandwiched between the negative electrode and a positive electrode as required by amended independent claim 1. Accordingly, one of ordinary skill in the art would not combine the teachings of the Orsini publication with those of the Munshi application. Furthermore, the Orsini publication describes the formation of dendrites which are grown by linkage of lithium (metal component) alone. In contrast, the claimed invention requires a negative electrode made from a metal component, such as gold, lead, tin, zinc, etc., and a lithium alloy attaches to the surface of the metal component. Accordingly, the production process of the negative electrode of the claimed invention is quite different than the growth process of the dendrites described in the Orsini publication, thereby leading to a structure that is different than what is described in the Orsini publication.

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For the foregoing reasons, the Applicants believe that the subject matter of amended independent claim 1 is not rendered obvious by the combination of the Munshi publication, the Skotheim patent, and the Orsini publication. Reconsideration of the rejection of claim 1 is respectfully requested.

Claims 2-8 and 16 depend from and add further limitations to amended independent claim 1, and are believed to be patentable for at least the reasons discussed hereinabove in connection with amended independent claim 1. Reconsideration of the rejection of claims 2-8 and 16 is respectfully requested.

IV. New Claim

New claim 17 has been added by this Amendment. New claim 17 depends from and adds further limitation to amended independent claim 1. No new matter has been added. Support for this claim can be found in the specification and drawings as originally filed. Specifically, support for this claim can be found in FIG. 1 and on page 6, line 22 to page 7, line 29 of the specification of the present application. New claim 17 is also believed to be allowable over the prior art of record because there is no teaching or suggestion in the Munshi publication, the Skotheim patent, and the Orsini publication of a projecting part of the negative electrode that is formed in a boundary region with the polymer electrolyte and has a border line that is a substantially cyclical curve. The Examiner relies on the dendrite formations of the Orsini publication as being equivalent to the projecting part of the claimed invention. However, these dendrite formations clearly do not have a border line that is a substantially cyclical curve (*see* FIG. 5 of the Orsini publication) as required by new claim 17. Accordingly, the Applicants believe that the subject matter of new claim 17 is allowable over the prior art of record.

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V. Conclusion

Based on the foregoing amendments and remarks, reconsideration of the rejections and allowance of pending claims 1-8, 16, and 17 are respectfully requested. Should the Examiner have any questions or wish to discuss the application in further detail, the Examiner is invited to contact Applicants' undersigned representative by telephone at 412-471-8815.

Respectfully submitted,
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